Microwave Remote Sensing for Hydrology 2008, Oxnard – California, 20 - 22 October

Continuous passive microwave measurement in mountainous region from 550 m above ground level: experimental design

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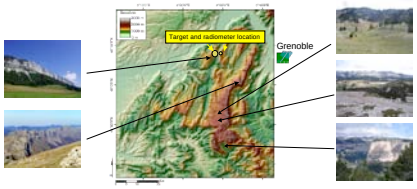
Abstract : An original microwave experiment is currently under development in Vercors, part of the French Alps near Grenoble (France) to measure continuous S-band (2.7 GHz) and L-band (1.4 GHz) soil-vegetation-snow emission. The main innovative character of the experiment is related to the use of a 500 m high natural cliff which provides a 300 m diameter footprint at the ground level. The scientific objectives are (i) to study the effect of heterogeneity of the field of view, (ii) to address topography effect, (iii) to observe the correlation between SMOS L-band brightness temperatures (about 30x30 km²) and S-band brightness temperatures obtained at the 0.1 km² scale, and (iv) to study the snow effect on the radiometric signal.

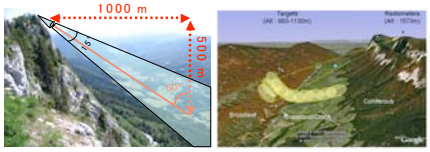
1) Location and description of the studied area in the French Alps (Vercors massif)

The **Vercors** is a plateau in the *départements* of Isère and Drôme in Eastern France. It is one of the ranges that form the French Prealps. It lies west from the Dauphiné Alps, from which it is separated by the rivers Drac and Isère. The cliffs at its eastern edge face the city of Grenoble.



2) Design of the radiometric experiment

The radiometer will be located at the top of a natural cliff in Vercors to provide a large field of view (about 100 000 m²) of the target located about 500 m above. The field of view will be heterogeous and composed with grassland, crops, coniferous and broadleaf forests.



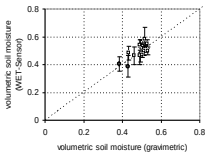
Experiment design of the microwave measurements over various land covers

Studied area from the radiometer location during spring (March 25th 2007) and during winter (February 7th 2008)

3) Ground soil moisture measurements

Ground soil moisture measurements were obtained during the SMOS Rehearsal campaign 2008 (April). Gravimetric soil moisture measurements were done over 16 sites covering the three main land-cover types (grassland, broadleaf forest and coniferous forest). In addition, volumetric soil moisture measurements were obtained using the WET Sensor® instrument.

Location of the two soil moisture transects and 16 gravimetric soil moisture measurements obtained on April 16th



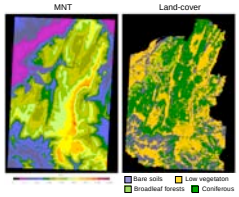
Volumetric soil moisture comparison obtained with gravimetric measurements and WET Sensor measurements.

4) Land surface simulation using the ISBA model at the 75 m resolution

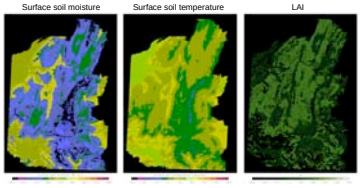
The ISBA 3-layer land surface model was used to simulate the temporal evolution of the soil and vegetation characteristics (soil moisture, soil temperature, leaf area index) for three kind of land covers (bare soils, herbaceous vegetation and forests). The ISBA model also simulated the snow dynamic (depth, density, temperature and snow liquid equivalent).

The atmospheric forcing is based on a single ground based meteorological station (Gerland). A correction of the air temperature is based on a 0.6°C per 100m (climatologic gradient). The limit snow/rain occurs at +1°C. Orientation is taken into account in the incoming shortwave radiation.

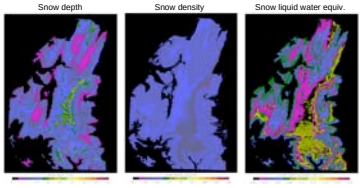
Land-cover information was provided by the Regional Natural Park of Vercors and is initially composed with about 70 land uses.



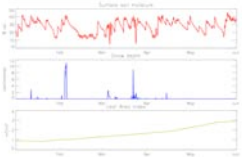
Digital elevation model and land-cover maps at the 75m resolution.



Soil (surface soil moisture and temperature) and vegetation (LAI) simulated with the ISBA land surface model on the February 4th 2008 1200



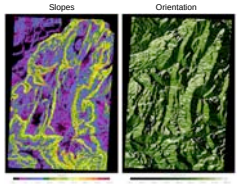
Snow characteristics (depth, density and liquid moisture) simulated with the ISBA land surface model on the February 4th 2008 1200



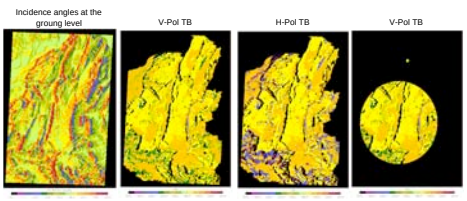
Temporal variation of surface soil moisture, snow depth and laef area index over a grassland pixel located in Romeyere

5) Microwave brightness temperatures simulation using the C-MEB model

Microwave TB are strongly dependent on the incidence angle. Thus, the digital elevation model was used to provide slope and orientation maps. The brightness temperatures were calculated using ISBA outputs, calculated incidence angles (depending on the satellite incidence angle, surface slope and orientation) and soil texture and roughness.



Slopes and pixel orientation of each 75-m pixels.



Incidence angles at the ground level for a 55° satellite angle measuring from the East direction and corresponding simulated TB V and H_Pol (May 31th 2008). Last view is the selected area for comparison between radiometer location and large view satellite measurements.

Temporal variation of simulated brightness temperature (V and H polarizations) from the radiometer location (red curves) and the 25 km diameter satellite measurement (black curves)

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